



# Telecommunications System Engineering Course

## Network Design Module Syllabus

### Module Purpose:

To develop a structured framework from which to understand and approach network design, and to provide a systematic, top-down process for designing telecommunications networks in the realm of the Global Information Grid (GIG) and commercial industry.

### Module Objectives:

- Develop an understanding of how mission objectives and requirements, and required services drive network design requirements.
- Understand the need for network analysis and how network analysis feeds into network design.
- Understand the structured network design process.
- Understand the logical and Physical design process for access, distribution, and core networks.
- Plan for host and network address allocation and naming.
- Understand switching and routing requirements in the network design process.
- Understanding network security and management strategies.
- Understand how to allocate and provision network services. Understand how User Requirement Documents, Functional Requirement Documents, System Design Plans, Engineering Installation Packages, and Configuration Documentation pertain to network design.

## Lesson 1a – Introduction to Network Design

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- The Need to Identify Requirements
  - Network Requirements
  - Meeting Performance Requirements
    - Application / Service Performance Demands
    - Network Performance Requirements
  - Meeting Availability Requirements
  - Meeting Security Requirements
  - Meeting Adaptability Requirements
  - Meeting Affordability Requirements
- Factors that Drive Requirements
- Structured Design Process
  - Design Review Process
  - Structured (Top Down) Design Process
  - Motivations for Structured Design
  - Prerequisites for the Design Process

## Lesson 1b – Identifying Requirements Part I

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- Understanding Network Design Requirements
  - Factors that define Network Design Requirements
  - Requirements and the Structured Network Design Process
  - Network Design Scope
  - Analyzing User Mission Objectives / Requirements, and Service Requirements
  - The User Requirements Document
  - Network Applications and other Considerations
- Analyzing Fundamental Network Design Requirements
  - Network Performance Requirements
  - Application Performance Demands
  - Availability Requirements
  - Security Requirements
  - Adaptability Requirements
  - Affordability Requirements
  - Manageability Requirements

## **Lesson 2a – Identifying Requirements Part II**

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- Analyzing the Existing Network
  - Analyzing the Existing Network Infrastructure
  - Network Naming and Addressing
  - Analyzing Wiring and Media
  - Benchmark the Existing Network
  - Network Analysis Tools

## **Lesson 2b – Identifying Requirements Part III**

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- Characterizing Network Traffic
  - Characterizing Network Traffic Flow
  - Characterizing Network Traffic Load
  - Characterizing Network Traffic Behavior
  
  - Characterizing Network Quality of Service

## **Lesson 3 – Logical Network Design Part I**

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- Designing a Logical Network Topology
  - Hierarchical Network Design
  - Flat vs. Hierarchical Network Topologies
  - Simple Network Topologies
  - Mesh Network Topologies
  - Three Layer Classic Hierarchical Model
- Guidelines for Hierarchical Network Design
- Core Network Design
  - Functions / Technology
  - Performance Considerations
  - Quality of Service Specifications and Requirements
  - Resiliency
- Distribution Network Design
  - Functions / Technology
  - Performance Considerations
  - Segmentation
- Functional Requirements Documentation

## Lesson 4a – Logical Network Design Part II

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- Access Network Design
  - Scope
  - Performance Considerations
  - Quality of Service Specifications and Requirements
  - Resiliency
- Building Redundancy into Network Topology
- Network Design Tools
- Network Address Allocation and Naming
  - Guidelines for Network Address Assignment
  - Using a Hierarchical Model for Network Address Assignment
  - Designing a Model for Naming

## Lesson 4b – Logical Network Design Part III

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- Switching and Routing Design Considerations
  - Switching and Routing Considerations in the Logical Network Design Process
  - Switching Options
  - Selecting Routing Protocols
  - Characterizing Routing Protocols
    - IP Routing
- Network Security and Management Design Strategies
  - Network Security Design
  - Security Mechanisms
  - Security Solutions
  - Network Management Design Considerations
    - Network Management Processes
    - Network Management Architectures
    - Network Management Tools and Protocols

## **Lesson 5a – Physical Network Design Part I: Core Area Networks**

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- Physical Network Design Process
- Selecting Technologies and Equipment for Core Area Networks
  - WAN Technologies
  - Provisioning Bandwidth
  - Selecting Devices for Enterprise WAN Design
  - Selecting ISPs for Enterprise WAN Design
  - Wide Area Network Design Example

## **Lesson 5b – Physical Network Design Part II: Distribution and Access Networks**

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- Physical Network Design Process
- LAN/CAN Technology and Wiring Solutions
  - Cable-Plant Design
  - LAN Technologies
    - Distribution Layer
    - Access Layer
- Selecting and Configuring Internetworking Devices for a Campus Network Design
- Selecting Technologies and Equipment for Access and Distribution Networks
- Remote Access

## **Lesson 6a – Network Services**

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- Defining Network Services
- Domain Name Services
- NetBIOS Name Services
- Configuring Network Services

## Lesson 6b – Network Design Considerations in the DISN

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- What is the DISN, and how does it relate to the I3A, and the Global Information Grid (GIG)?
- Installation Information Infrastructure Modernization Program (I3MP), and the Installation Information Infrastructure Architecture (I3A)
  - OSCAR II
  - CUITN
  - MTMP
  - DSSMP
  - ADRP
- Top Level Architecture (TLA)

## Annex A – Practical Exercises / Labs

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- Lab: Using OPNET Modeler as a Network Design Tool
- Lab: Network Design Optimization Lab using OPNET Modeler
- Case Study:
- Capstone Lab Practical Exercise

### Module Grading Structure:

Module Final Exam	20%
Network Design Capstone Lab	40%
Case Study / Labs	40%

### Texts and Reference Material:

Top Down Network Design, Priscilla Oppenheimer, Cisco Press, 1999  
C4ISR Integrated Planning Handbook, OASD C3I, 1998  
I3A Implementation Guide, Version 3, April 2001, USAISEC

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